

IMPROVEMENTS IN OR RELATING TO CONTAINERS

The present invention relates to a water-soluble container and to a process for the preparation of such a 5 container.

It is known to package chemical compositions, particularly those which may be of a hazardous or irritant nature, in films, particularly water-soluble films. Such 10 containers can simply be added to water in order to dissolve or disperse the contents of the container into the water.

For example, WO 89/12587 discloses a package, which comprises an envelope of a water-soluble material, which 15 comprises a flexible wall and a water-soluble heat seal. The package may contain an organic liquid comprising, for example, a pesticide, fungicide, insecticide or herbicide.

WO 92/17382 discloses a package containing an 20 agrochemical comprising a first sheet of non-planar water-soluble or water-dispersible material and a second sheet of water-soluble or water-dispersible material superposed on the first sheet and sealed to it.

25 WO 01/85898 discloses a two-compartment water-soluble package in which an open compartment is sealed with a pre-sealed compartment.

Such arrangements have, however, a number of 30 difficulties. In particular, there may be difficulties if the packages contain compositions which generate a gas because the gas inflates the packages, particularly if they

are flexible, and may burst them. Such packages are especially susceptible to bursting at weak points such as at the seals. We have found that this problem may occur with compositions with moisture-sensitive components, such as a 5 peracid bleach, which generate gas upon coming into contact with water or water-vapour, which may permeate into the interior of the package through the package walls.

The present invention provides a water-soluble 10 container comprising at least one first compartment, each first compartment containing a composition that comprises less than 5 wt% free water, and a second compartment containing a second composition, wherein the second composition generates a gas on exposure to the atmosphere or 15 water, and more than 50% of the surface area of the second compartment is enclosed by the first compartment or first compartments.

The present invention also provides a process for 20 producing a container as defined above, which comprises:
i) forming an open container, at least partially filling the container with the first composition and with the second compartment containing the second composition and sealing the container to form the first compartment; or
25 ii) forming an open container, at least partially filling the container with the first composition and sealing the container to form the first compartment, said container being sealed with a sealing member, such as a film, having a second compartment comprising the second composition.

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The term "water-soluble" is taken to include water dispersible.

The term "free water" is defined in WO 02/16222, herein incorporated by reference. There is not necessarily a direct correlation between the total amount of water present in a 5 composition and the amount of free water, as required in the present invention. Free water does not include water which is not available to the surrounding compartment such as water held within a gelled matrix or water of solvation of any components present in the composition.

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In order to determine the amount of free water present in a composition, a standard loss-on-drying determination test may be carried out. A sample of the composition, usually about 10 g, is weighed, and then maintained at 60°C 15 for 3 hours under a partial vacuum of 200 mbar (20 kPa). The sample is then re-weighed, and the weight lost determined. In the present invention, the loss on drying the first composition must be less than 5 wt%, preferably less than 4, 3, 2 or 1 wt%. Even more preferably the first 20 composition is anhydrous. The first composition may be a solid or a liquid.

Preferably, the second composition comprises less than 5 wt % free water, preferably less than 4, 3, 2 or 1 wt%. 25 Even more preferably the second composition is anhydrous. The second composition may be a solid or a liquid.

The second composition may generate a gas for a number of reasons. For example, the second composition may generate 30 a gas by interaction with one or more components of the atmosphere, especially water vapour or oxygen, which may diffuse or otherwise travel through the container walls. The

second composition may also generate a gas, for example, when exposed to other components that can diffuse or otherwise travel through the container walls other than from the atmosphere, for example from adjacent or attached 5 compartments.

As indicated above, we have found that certain compositions release a gas when contacted with water or water vapour. Surprisingly, this can occur even when these 10 moisture-sensitive compositions are surrounded by a wall of a material. We have, in particular, found that some materials used as walls of water-soluble containers may not be completely water-impermeable, but may have a degree of water-permeability. While the degree of water-permeability 15 may be slight, it may be sufficient to allow a small amount of water to permeate through the wall, for example, from the atmosphere. Since water-soluble containers may be stored for some time, for example for several months or even years, gas may gradually be generated by contact of the moisture- 20 sensitive composition with water, which may consequently cause the container to burst from the increase in gas pressure inside the container. The container may burst by means of a tear through the wall or by failure of a seal. It may also burst internally, allowing different 25 compositions held within the container to mix. This problem is eliminated or at least alleviated in the containers of the present invention in which the second compartment is at least partially shielded from the atmosphere by the first compartment. Thus, the amount of gas produced by the second 30 composition is reduced, or even eliminated. For this reason, the risk of bursting due to the internal generation of a gas is reduced, or even eliminated.

In the containers of the present invention, more than 50% of the outer surface area of the second compartment is enclosed by the first compartment. Preferably, more than 5 60%, for example, 70% to 100%, especially 80% to 90% of the surface area of the second compartment is enclosed by the first compartment. The container of the present invention may comprise only the first and second compartments, or may comprise one or more further compartments. The further 10 compartments may also be partly or fully enclosed by at least one of the first compartment(s) if desired.

15 The gas may be any gas but is usually one or more of O₂, CO₂, N₂, Cl₂, HCl or the volatile ingredients of a fragrance.

15 The container may, if desired, include a gas release means. The gas release means may take any form that allows the escape of gas generated inside one or more compartments of the container. In particular the first compartment 20 and/or the second compartment may comprise a gas release means. A gas release means may be present in the first compartment since this compartment is not shielded from the atmosphere. A gas release means may be present in the second compartment to assist further in preventing the 25 build-up of a gas in the compartment. Preferably, the gas release means is included in the second compartment. Therefore, the surface area of the second compartment enclosed by the first compartment(s) may be less than 100% to allow the second compartment to expel gas.

30 The incorporation of a gas release means into the second compartment of the container may alleviate or prevent

the danger of the container bursting due to the build up of gas. However, it is still important to prevent or slow down the degradation of such gas generating components, such as peracid bleach, so as to preserve their effectiveness upon 5 use.

The gas release means may, for example, take the form of a vent. A vent may comprise a one-way valve, for example one or more holes covered with one or more flaps. Most 10 preferably, however, the vent is simply one or more holes. A single hole may be provided, although an array, either regular or irregular, may also be provided. Suitably, the hole or holes each have a maximum dimension of 0.1 to 2 mm. The maximum dimension is the diameter of the hole if the 15 hole is circular. Preferably the hole or holes have a maximum dimension of 0.2 to 1.5 mm, especially about 0.5 to 1 mm, more especially about 0.8 mm.

The vent may be provided simply by forming a hole or 20 holes in the container, for example by use of a needle. Other means such as a laser, a strong gas beam or a projectile such as a particle may also be used. The hole or holes are generally provided after the container has been formed, although it may also be provided earlier in the 25 process if desired. It is also possible to include a hole or holes at the time of forming the container, for example, by providing a mould with means of an appropriate shape to form the hole or holes at the same time that the container is formed.

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The gas release means may also, for example, comprise a permeable wall or wall section of one or more compartments

of the container. An example is a permeable wall or wall section that has microchannels therein. Such microchannels can be formed by any means. For example, the microchannels may be provided by including particles in the wall or wall 5 section. Suitable particles are polyethylene, polypropylene or starch particles. Preferably, the particles are water-soluble. These particles may be included in the polymer composition, for example, by using a bi-injection moulding process. In general, the particles have a diameter of at 10 least the wall thickness. The amount of particles included should be such that agglomerates form.

Another possible way of providing the container with gas release means is to form at least part of the container 15 with a polymer that is inherently gas permeable. It is, of course, necessary that the polymer is permeable to the gas being generated inside the container. An example of such a polymer is a cellulose derivative.

20 A further possibility is to generate a gas pressure sensitive membrane, for example comprising areas of weakness in the container designed to open as the gas pressure rises in the container. Areas of weakness can easily be generated by, for example, pressing a dimpled stamp onto the surface.

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If a gas release means is present, it should be such that it does not allow any of the liquid or solid contents of the container to leak out until the container is dissolved in water.

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The container of the present invention can have an attractive appearance because it contains at least two

compositions, which are advantageously held in a fixed position in relation to each other. The compositions can be easily differentiated to accentuate their difference. For example, the compositions may be coloured differently, or 5 may be in a different physical state. The first composition and the second composition are independently in the form of, for example, a liquid (e.g. a thickened liquid or gel) or a solid (e.g. a powder, granules or a compressed solid). In one embodiment, the first composition is a liquid or gel, 10 while the second composition is a solid or semi-solid. Thus, for example, the container can have an appearance of a fried egg or eyeball.

The container may contain two components that are 15 incompatible with each other. It may also contain a component that is incompatible with the part of the container enclosing the other component. For example, one composition may be incompatible with the part of the container enclosing another composition.

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In one embodiment, one or more second compartments are fully enclosed by the first compartment. For example, the second composition may be enclosed in a second compartment formed of, for example, a film of a water-soluble polymer. 25 Another possibility is for the second composition to be coated with a water-soluble polymer, for example by spraying. The second compartment may be placed in a container (first compartment) containing the first composition. Thus, the second compartment may be regarded 30 as an inner compartment within an outer compartment (first compartment) defined by the container. Both the outer compartment and inner compartment(s) may each be provided

with gas release means, such as the ones herein described. Alternatively, only the inner or the outer compartment is provided with a gas release means.

5 The second compartment may be fixed to the first compartment, or may be free. Such containers can be produced by any method, for example, by forming the outer compartment, filling it with the desired composition and the pre-prepared inner compartment, and then sealing the outer
10 compartment. The outer compartment and the inner compartment can be produced by any method. Examples of suitable methods by which each compartment may be independently prepared are vertical form fill sealing, thermoforming and injection moulding.

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Where the first or second composition is in the form of a solid, the solid may be coated, for example, spray coated with a material, which solidifies to form the compartment for the solid. For example, the solid may be coated with a
20 water-soluble polymer. Suitable polymers include poly(vinyl alcohol) (PVOH), cellulose derivatives such as hydroxypropyl methyl cellulose (HPMC) and gelatin. Preferably, HPMC is employed. Spray coating is useful for enclosing solids that are relatively small, for example, 5 to 30 mm, preferably,
25 10 to 20 mm in dimension. For example, it may be difficult to enclose a solid having such small dimensions using a thermoformed sheet of material, without creating unacceptably large seal areas. In a preferred embodiment, the second compartment is formed by a coated, such as a
30 spray-coated, layer of material. In such an embodiment, the second compartment may take the form of a sphere containing the second composition. For example, the second composition

may be a compacted solid composition consisting of or comprising a bleach.

5 The thickness of the coating is preferably 40 to 300 μm , more preferably, 80 to 200 μm , especially, 100 to 160 μm , more especially, 100 to 150 and most especially, 120 to 1550 μm .

10 In an alternative embodiment, the container comprises a first compartment containing the first composition, and a sealing member that is employed to seal the first composition in the first compartment, as illustrated in WO 01/85898, although care will need to be taken to ensure that the compartments have the special relationship herein defined. The sealing member comprises a second compartment for the second composition. For example, the second compartment may take the form of a housing attached to the underside of the sealing member. When the sealing member is positioned over the first compartment, the housing is located within the first compartment. The housing may share at least one wall section or wall in common with the sealing member. The remaining walls or wall sections of the housing may be surrounded by the first composition in the first compartment. Preferably, from 50 to 90 %, more preferably from 60 to 80%, of the surface area of the housing is enclosed by the first compartment. In this embodiment, the sealing member may be provided with a gas release means, for example, one of the means herein described.

30 The container of the present invention may have more than two compartments, for example, three, four, five or six compartments. In one embodiment, the first compartment is

divided into two or more sub-compartments, for example, three or four compartments. Each of these compartments may contain a different composition. Alternatively, some or all of the compartments may contain the same composition. The 5 second compartment may also be divided into a number of sub-compartments, for example, two, three, four or five sub-compartments. Each of these compartments may contain a different composition. Alternatively, some or all of the compartments may contain the same composition. Each of the 10 compartments may be formed using any suitable material. For example, any one of the materials herein described may be employed.

The water permeability of the material used for the 15 container as a whole or the first and/or second compartment is greater than 1, 3, 6 or 15 g/m²/day. Preferably the water permeability of the material is less than 50, 40, 35, 30 g/m²/day.

20 In one embodiment, the container comprises a second compartment, which is enclosed by two or more first compartments. In this way, more than 50% of the surface area of the second compartment is enclosed by the two or more first compartments. Preferably, the second compartment is 25 sandwiched between two or more first compartments.

It is possible to ensure that one of the compositions 30 is released at a different time to the other(s). For instance, one composition can be released immediately the container is added to water, whereas the other may be released later. This may be achieved by having a compartment that takes longer to dissolve surrounding one of

the compositions. This may be achieved, for example, by having different compartment wall thicknesses. It may also be achieved by choosing compartment walls that dissolve at different temperatures, for example the different 5 temperatures encountered during the cycle of a laundry or dish washing machine.

In one embodiment, the first compartment is of, for example, a moulded composition, especially one produced by 10 injection moulding or blow moulding. The first compartment may have a wall thickness of, for example, greater than 100 μm , for example greater than 150 μm or greater than 200 μm , 300 μm , 500 μm , 750 μm or 1mm. Preferably, the wall thickness is from 200 to 400 μm .

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The first compartment may also, for example, be formed of a film. The film may be a single film, or a laminated film as disclosed in GB-A-2,244,258. While a single film may have pinholes, the two or more layers in a laminate are 20 unlikely to have pinholes that coincide.

The film may be produced by any process, for example by extrusion and blowing or by casting. The film may be unoriented, monoaxially oriented or biaxially oriented. If 25 the layers in the film are oriented, they usually have the same orientation, although their planes of orientation may be different if desired.

The layers in a laminate may be the same or different. 30 Thus they may each comprise the same polymer or a different polymer.

Examples of water-soluble polymers which may be used in a single layer film or in one or more layers of a laminate or which may be used for injection moulding or blow moulding are poly(vinyl alcohol) (PVOH), cellulose derivatives such as hydroxypropyl methyl cellulose (HPMC) and gelatin. An example of a preferred PVOH is ethoxylated PVOH. The PVOH may be partially or fully alcoholised or hydrolysed. For example it may be from 40 to 100%, preferably from 70 to 92%, more preferably about 88% or about 92%, alcoholised or hydrolysed. The degree of hydrolysis is known to influence the temperature at which the PVOH starts to dissolve in water. 88% hydrolysis corresponds to a film soluble in cold (ie room temperature) water, whereas 92% hydrolysis corresponds to a film soluble in warm water.

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The thickness of the film used to produce the container, is preferably 40 to 300 μm , more preferably 80 to 200 μm , especially 100 to 160 μm , more especially 100 to 150 μm and most especially 120 to 150 μm .

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In one embodiment, the film is vacuum formed or thermoformed into a first compartment or pocket for the first composition. For example, in a thermoforming process the film may be drawn down or blown down into a mould.

25 Thus, for example, the film is heated to the thermoforming temperature using a thermoforming heater plate assembly, and then drawn down under vacuum or blown down under pressure into the mould. Plug-assisted thermoforming and pre-stretching the film, for example by blowing the film away from the mould before thermoforming, may, if desired, be used. One skilled in the art can choose an appropriate temperature, pressure or vacuum and dwell time to achieve an

appropriate shape. The amount of vacuum or pressure and the thermoforming temperature used depend on the thickness and porosity of the film and on the polymer or mixture of polymers being used. Thermoforming of PVOH films is known 5 and described in, for example, WO 00/55045 and WO 01/85898.

A suitable forming temperature for PVOH or ethoxylated PVOH is, for example, from 90 to 130°C, especially 90 to 120°C. A suitable forming pressure is, for example, 69 to 10 138kPa (10 to 20 p.s.i.), especially 83 to 117 kPa (12 to 17 p.s.i.). A suitable forming vacuum is 0 to 4 kPa (0 to 40 mbar), especially 0 to 2 kPa (0 to 20 mbar). A suitable dwell time is, for example, 0.4 to 2.5 seconds, especially 2 to 2.5 seconds.

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While desirably conditions chosen within the above ranges, it is possible to use one or more of these parameters outside the above ranges, although it may be necessary to compensate by changing the values of the other 20 two parameters.

Once formed, the pocket may be filled with the first composition. The pocket may be completely filled or only partially filled. The composition may be a solid. For 25 example, it may be a particulate or granulated solid, or a tablet. Preferably, however, the first composition is a liquid, which may be thickened or gelled, if desired. More preferably, the first composition is a transparent liquid, especially, a coloured, transparent liquid. The liquid 30 composition may be non-aqueous or aqueous, although comprising less than 5% free water as defined in WO 02/16222. The composition may have more than one phase.

For example it may comprise an aqueous composition and a liquid composition that is immiscible with the aqueous composition. It may also comprise a liquid composition and a separate solid composition, for example in the form of a 5 ball, pill or speckles.

The actual amount of water present in the first or second composition may be in excess of the amount of free water as defined above since the total water content 10 includes water of solvation and water held within a gelled matrix. The total amount of water in the first and/or second composition is, for example, more than 5, 10, 15, 20, 25 or 30wt%. The total water content may be less than 80 wt%, for example less than 70, 60, 50, 40 wt%.

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The first composition may be any composition that is intended to be released in an aqueous environment. Thus, for example, it may be an agrochemical composition such as a plant protection agent, for instance a pesticide such as an 20 insecticide, fungicide, herbicide, acaricide, or nematocide, a plant growth regulator or a plant nutrient. Such compositions are generally packaged in amounts of from 0.1 g to 7 kg, preferably 1 to 5 kg, when in solid form. When in liquid or gelled form, such compositions are generally 25 packaged in amounts of from 1 ml to 10 litres, preferably 0.1 to 6 litres, especially from 0.5 to 1.5 litres.

The first composition may also be a fabric care, surface care or dishwashing composition. Thus, for example, 30 it may be a dishwashing, water-softening, laundry or detergent composition, or a rinse aid. Such compositions may be suitable for use in a domestic washing machine. The

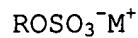
composition may also be a disinfectant, antibacterial or antiseptic composition, or a refill composition for a trigger-type spray. Such compositions are generally packaged in amounts of from 5 to 100 g, especially from 15 5 to 40 g. For example, a dishwashing composition may weigh from 15 to 30 g, a water-softening composition may weigh from 15 to 40 g. Preferably, the first composition is a detergent composition for laundry.

10 The first composition, if in liquid form, may be anhydrous. Alternatively, the first composition may comprise water, preferably, in an amount of from 0 to 10 wt %, more preferably, from 0 to 5 wt %, and especially, from 0 to 2 wt %.

15 The remaining ingredients of the first composition depend on the use of the composition. Thus, for example, the composition may contain surface active agents such as an anionic, nonionic, cationic, amphoteric or zwitterionic 20 surface active agents or mixtures thereof.

Examples of anionic surfactants are straight-chained or branched alkyl sulfates and alkyl polyalkoxylated sulfates, also known as alkyl ether sulfates. Such surfactants may be 25 produced by the sulfation of higher C₈-C₂₀ fatty alcohols.

Examples of primary alkyl sulfate surfactants are those of formula:



30 wherein R is a linear C₈-C₂₀ hydrocarbyl group and M is a water-solubilising cation. Preferably R is C₁₀-C₁₆ alkyl,

for example C₁₂-C₁₄, and M is alkali metal such as lithium, sodium or potassium.

Examples of secondary alkyl sulfate surfactants are
 5 those which have the sulfate moiety on a "backbone" of the molecule, for example those of formula:



wherein m and n are independently 2 or more, the sum of m+n typically being 6 to 20, for example 9 to 15, and M is a
 10 water-solubilising cation such as lithium, sodium or potassium.

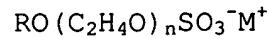
Especially preferred secondary alkyl sulfates are the (2,3) alkyl sulfate surfactants of formulae:

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20 for the 2-sulfate and 3-sulfate, respectively. In these formulae x is at least 4, for example 6 to 20, preferably 10 to 16. M is cation, such as an alkali metal, for example lithium, sodium or potassium.

25 Examples of alkoxylated alkyl sulfates are ethoxylated alkyl sulfates of the formula:



30 wherein R is a C₈-C₂₀ alkyl group, preferably C₁₀-C₁₈ such as a C₁₂-C₁₆, n is at least 1, for example from 1 to 20, preferably 1 to 15, especially 1 to 6, and M is a salt-

forming cation such as lithium, sodium, potassium, ammonium, alkylammonium or alkanolammonium. These compounds can provide especially desirable fabric cleaning performance benefits when used in combination with alkyl sulfates.

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The alkyl sulfates and alkyl ether sulfates will generally be used in the form of mixtures comprising varying alkyl chain lengths and, if present, varying degrees of alkoxylation.

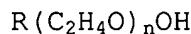
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Other anionic surfactants which may be employed are salts of fatty acids, for example C₈-C₁₈ fatty acids, especially the sodium or potassium salts, and alkyl, for example C₈-C₁₈, benzene sulfonates.

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Examples of nonionic surfactants are fatty acid alkoxylates, such as fatty acid ethoxylates, especially those of formula:

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wherein R is a straight or branched C₈-C₁₆ alkyl group, preferably a C₉-C₁₅, for example C₁₀-C₁₄, alkyl group and n is at least 1, for example from 1 to 16, preferably 2 to 12, 25 more preferably 3 to 10.

The alkoxylated fatty alcohol nonionic surfactant will frequently have a hydrophilic-lipophilic balance (HLB) which ranges from 3 to 17, more preferably from 6 to 15, most

30 preferably from 10 to 15.

Examples of fatty alcohol ethoxylates are those made from alcohols of 12 to 15 carbon atoms and which contain about 7 moles of ethylene oxide. Such materials are commercially marketed under the trademarks Neodol 25-7 and 5 Neodol 23-6.5 by Shell Chemical Company. Other useful Neodols include Neodol 1-5, an ethoxylated fatty alcohol averaging 11 carbon atoms in its alkyl chain with about 5 moles of ethylene oxide; Neodol 23-9, an ethoxylated primary C₁₂-C₁₃ alcohol having about 9 moles of ethylene oxide; and 10 Neodol 91-10, an ethoxylated C₉-C₁₁ primary alcohol having about 10 moles of ethylene oxide.

Alcohol ethoxylates of this type have also been marketed by Shell Chemical Company under the Dobanol 15 trademark. Dobanol 91-5 is an ethoxylated C₉-C₁₁ fatty alcohol with an average of 5 moles ethylene oxide and Dobanol 25-7 is an ethoxylated C₁₂-C₁₅ fatty alcohol with an average of 7 moles of ethylene oxide per mole of fatty alcohol.

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Other examples of suitable ethoxylated alcohol nonionic surfactants include Tergitol 15-S-7 and Tergitol 15-S-9, both of which are linear secondary alcohol ethoxylates available from Union Carbide Corporation. Tergitol 15-S-7 25 is a mixed ethoxylated product of a C₁₁-C₁₅ linear secondary alkanol with 7 moles of ethylene oxide and Tergitol 15-S-9 is the same but with 9 moles of ethylene oxide.

Other suitable alcohol ethoxylated nonionic surfactants 30 are Neodol 45-11, which is a similar ethylene oxide condensation products of a fatty alcohol having 14-15 carbon atoms and the number of ethylene oxide groups per mole being

about 11. Such products are also available from Shell Chemical Company.

Further nonionic surfactants are, for example, C₁₀-C₁₈ 5 alkyl polyglycosides, such as C₁₂-C₁₆ alkyl polyglycosides, especially the polyglucosides. These are especially useful when high foaming compositions are desired. Further surfactants are polyhydroxy fatty acid amides, such as C₁₀-C₁₈ 10 N-(3-methoxypropyl) glyciamides and ethylene oxide-propylene oxide block polymers of the Pluronic type.

Examples of cationic surfactants are those of the quaternary ammonium type.

15 The total content of surfactants in the composition is desirably 60 to 95 wt%, especially 75 to 90 wt%. Desirably an anionic surfactant is present in an amount of 50 to 75 wt%, the nonionic surfactant is present in an amount of 5 to 50 wt%, and/or the cationic surfactant is present in an 20 amount of from 0 to 20 wt%. The amounts are based on the total solids content of the composition, i.e. excluding any solvent which may be present.

The compositions, particularly when used as laundry 25 washing or dishwashing compositions, may also independently comprise enzymes, such as protease, lipase, amylase, cellulase and peroxidase enzymes. Such enzymes are commercially available and sold, for example, under the registered trade marks Esperase, Alcalase and Savinase by 30 Nova Industries A/S and Maxatase by International Biosynthetics, Inc. Desirably the enzymes are independently present in the compositions in an amount of

from 0.5 to 3 wt%, especially 1 to 2 wt%, when added as commercial preparations they are not pure and this represents an equivalent amount of 0.005 to 0.5 wt% of pure enzyme.

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The compositions may, if desired, independently comprise a thickening agent or gelling agent. Suitable thickeners are polyacrylate polymers such as those sold under the trade mark CARBOPOL, or the trade mark ACUSOL by Rohm and Haas Company. Other suitable thickeners are xanthan gums. The thickener, if present, is generally present in an amount of from 0.2 to 4 wt%, especially 0.5 to 2 wt%.

15 Compositions used in dishwashing independently usually comprise a detergency builder. The builders counteract the effects of calcium, or other ion, water hardness. Examples of such materials are citrate, succinate, malonate, carboxymethyl succinate, carboxylate, polycarboxylate and 20 polyacetyl carboxylate salts, for example with alkali metal or alkaline earth metal cations, or the corresponding free acids. Specific examples are sodium, potassium and lithium salts of oxydisuccinic acid, mellitic acid, benzene polycarboxylic acids, C₁₀-C₂₂ fatty acids and citric acid.

25 Other examples are organic phosphonate type sequestering agents such as those sold by Monsanto under the trade mark Dequest and alkylhydroxy phosphonates. Citrate salts and C₁₂-C₁₈ fatty acid soaps are preferred. Further builders are; phosphates such as sodium, potassium or ammonium salts of 30 mono-, di- or tri-poly or oligo-phosphates; zeolites; silicates, amorphous or structured, such as sodium, potassium or ammonium salts.

Other suitable builders are polymers and copolymers known to have builder properties. For example, such materials include appropriate polyacrylic acid, polymaleic acid, and polyacrylic/polymaleic and copolymers and their salts, such as those sold by BASF under the trade mark Sokalan.

The builder is desirably present in an amount of up to 10 90 wt%, preferably 15 to 90 wt%, more preferable 15 to 75 wt%, relative to the total weight of the composition. Further details of suitable components are given in, for example, EP-A-694,059, EP-A-518,720 and WO 99/06522.

15 The compositions can also optionally comprise one or more additional ingredients. These include conventional detergent composition components such as further surfactants, bleaches, bleach enhancing agents, builders, suds boosters or suds suppressors, anti-tarnish and anti-20 corrosion agents, organic solvents, co-solvents, phase stabilisers, emulsifying agents, preservatives, soil suspending agents, soil release agents, germicides, pH adjusting agents or buffers, non-builder alkalinity sources, chelating agents, clays such as smectite clays, enzyme 25 stabilizers, anti-limescale agents, colourants, dyes, hydrotropes, dye transfer inhibiting agents, brighteners, and perfumes. If used, such optional ingredients will generally constitute no more than 10 wt%, for example from 1 to 6 wt%, the total weight of the compositions.

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Compositions which comprise an enzyme may optionally contain materials which maintain the stability of the

enzyme. Such enzyme stabilizers include, for example, polyols such as propylene glycol, boric acid and borax. Combinations of these enzyme stabilizers may also be employed. If utilized, the enzyme stabilizers generally 5 constitute from 0.1 to 1 wt% of the compositions.

The compositions may optionally comprise materials which serve as phase stabilizers and/or co-solvents. Examples are C₁-C₃ alcohols such as methanol, ethanol and 10 propanol. C₁-C₃ alkanolamines such as mono-, di- and triethanolamines can also be used, by themselves or in combination with the alcohols. The phase stabilizers and/or co-solvents can, for example, constitute 0 to 1 wt%, preferably 0.1 to 0.5 wt%, of the composition.

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The compositions may optionally comprise components which adjust or maintain the pH of the compositions at optimum levels. The pH may be from, for example, 1 to 13, such as 8 to 11 depending on the nature of the composition. 20 For example a dishwashing composition desirably has a pH of 8 to 11, a laundry composition desirable has a pH of 7 to 9, and a water-softening composition desirably has a pH of 7 to 9. Examples of pH adjusting agents are NaOH and citric acid.

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The above examples may be used for dish or fabric washing. In particular dish washing formulations are preferred which are adapted to be used in automatic dish washing machines. Due to their specific requirements 30 specialised formulation is required and these are illustrated below

Amounts of the ingredients can vary within wide ranges, however preferred automatic dishwashing detergent compositions herein (which typically have a 1% aqueous solution pH of above 8, more preferably from 9.5 to 12, most 5 preferably from 9.5 to 10.5) are those wherein there is present: from 5% to 90%, preferably from 5% to 75%, of builder; from 0.1% to 40%, preferably from 0.5% to 30%, of bleaching agent; from 0.1% to 15%, preferably from 0.2% to 10%, of the surfactant system; from 0.0001% to 1%, 10 preferably from 0.001% to 0.05%, of a metal-containing bleach catalyst; and from 0.1% to 40%, preferably from 0.1% to 20% of a water-soluble silicate. Such fully-formulated embodiments typically further comprise from 0.1% to 15% of a polymeric dispersant, from 0.01% to 10% of a chelant, and 15 from 0.00001% to 10% of a deterotive enzyme, though further additional or adjunct ingredients may be present. Detergent compositions herein in granular form typically limit water content, for example to less than 7% free water, for better storage stability.

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Non-ionic surfactants useful in ADW (Automatic Dish Washing) compositions of the present invention desirably include surfactant(s) at levels of from 2% to 60% of the composition. In general, bleach-stable surfactants are 25 preferred. Non-ionic surfactants generally are well known, being described in more detail in Kirk Othmer's Encyclopedia of Chemical Technology, 3rd Ed., Vol. 22, pp. 360-379, "Surfactants and Deterotive Systems", incorporated by reference herein.

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Preferably the ADW composition comprises at least one non-ionic surfactant. One class of non-ionics are

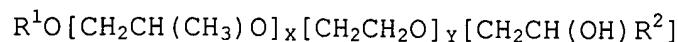
ethoxylated non-ionic surfactants prepared by the reaction of a monohydroxy alkanol or alkylphenol with 6 to 20 carbon atoms with preferably at least 12 moles particularly preferred at least 16 moles, and still more preferred at least 20 moles of ethylene oxide per mole of alcohol or alkylphenol.

Particularly preferred non-ionic surfactants are the non-ionic from a linear chain fatty alcohol with 16-20 carbon atoms and at least 12 moles particularly preferred at least 16 and still more preferred at least 20 moles of ethylene oxide per mole of alcohol.

According to one preferred embodiment the non-ionic surfactant additionally comprise propylene oxide units in the molecule. Preferably this PO units constitute up to 25% by weight, preferably up to 20% by weight and still more preferably up to 15% by weight of the overall molecular weight of the non-ionic surfactant. Particularly preferred surfactants are ethoxylated mono-hydroxy alkanols or alkylphenols, which additionally comprises polyoxyethylene-polyoxypropylene block copolymer units. The alcohol or alkylphenol portion of such surfactants constitutes more than 30%, preferably more than 50%, more preferably more than 70% by weight of the overall molecular weight of the non-ionic surfactant.

Another class of non-ionic surfactants includes reverse block copolymers of polyoxyethylene and polyoxypropylene and block copolymers of polyoxyethylene and polyoxypropylene initiated with trimethylolpropane.

Another preferred non-ionic surfactant can be described by the formula:

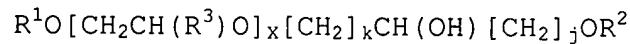


5

wherein R^1 represents a linear or branched chain aliphatic hydrocarbon group with 4-18 carbon atoms or mixtures thereof, R^2 represents a linear or branched chain aliphatic hydrocarbon rest with 2-26 carbon atoms or mixtures thereof, x is a value between 0.5 and 1.5 and y is a value of at least 15.

Another group of preferred nonionic surfactants are the end-capped polyoxyalkylated non-ionics of formula:

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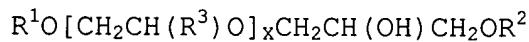


wherein R^1 and R^2 represent linear or branched chain, saturated or unsaturated, aliphatic or aromatic hydrocarbon groups with 1-30 carbon atoms, R^3 represents a hydrogen atom or a methyl, ethyl, n-propyl, iso-propyl, n-butyl, 2-butyl or 2-methyl-2-butyl group, x is a value between 1 and 30 and, k and j are values between 1 and 12, preferably between 1 and 5. When the value of x is ≥ 2 each R^3 in the formula above can be different. R^1 and R^2 are preferably linear or branched chain, saturated or unsaturated, aliphatic or aromatic hydrocarbon groups with 6-22 carbon atoms, where group with 8 to 18 carbon atoms are particularly preferred. For the group R^3 H, methyl or ethyl are particularly preferred. Particularly preferred values for x are comprised between 1 and 20, preferably between 6 and 15.

As described above, in case $x \geq 2$, each R^3 in the formula can be different. For instance, when $x=3$, the group R^3 could be chosen to build ethylene oxide ($R^3=H$) or propylene oxide (5 $R^3=methyl$) units which can be used in every single order for instance $(PO)(EO)(EO)$, $(EO)(PO)(EO)$, $(EO)(EO)(PO)$, $(EO)(EO)(EO)$, $(PO)(EO)(PO)$, $(PO)(PO)(EO)$ and $(PO)(PO)(PO)$. The value 3 for x is only an example and bigger values can be chosen whereby a higher number of variations of (EO) or 10 (PO) units would arise.

Particularly preferred end-capped polyoxyalkylated alcohols of the above formula are those where $k=1$ and $j=1$ originating molecules of simplified formula:

15



The use of mixtures of different non-ionic surfactants is particularly preferred in ADW formulations for example 20 mixtures of alkoxylated alcohols and hydroxy group containing alkoxylated alcohols.

The first composition may optionally comprise materials which serve as phase stabilizers and/or co-solvents. 25 Example are C_1-C_3 alcohols such as methanol, ethanol and propanol. C_1-C_3 alkanolamines such as mono-, di- and triethanolamines can also be used, by themselves or in combination with the alcohols. The phase stabilizers and/or co-solvents can, for example, constitute 0 to 1 wt%, 30 preferably 0.1 to 0.5 wt%, of the composition.

The first composition may optionally comprise components which adjust or maintain the pH of the compositions at optimum levels. The pH may be from, for example, 1 to 13, such as 8 to 11 depending on the nature of 5 the composition. For example a dishwashing composition desirably has a pH of 8 to 11, a laundry composition desirable has a pH of 7 to 9, and a water-softening composition desirably has a pH of 7 to 9. Examples of pH adjusting agents are NaOH and citric acid.

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The second composition may be any composition that generates a gas on exposure to the atmosphere or water. This generation need not be instantaneous. The composition may only generate a gas gradually or over an extended 15 period, for example several weeks or months, or even up to one year. Preferably, the second composition comprises a moisture-sensitive component. For example, the second composition may be or may contain a bleach. Examples of bleaches are, for example, listed in WO 99/06522. These 20 include oxygen releasing bleaching agent such as a hydrogen peroxide source and an organic peroxyacid bleach precursor compound or a preformed organic peroxyacid. Examples of hydrogen peroxide sources are inorganic perhydrate bleaches such as the alkali metal salts of perborate, percarbonate, 25 perphosphate, persulfate and persilicates. Examples of organic peroxyacid bleach precursors are listed in WO 99/06522. The bleaches also include chlorine releasing agents such as hydantoins, for example 1,3-dichloro-5,5-dimethyl hydantoin, hypochlorites such as sodium 30 hypochlorite or dichloroisocyanurates such as sodium dichloroisocyanurate.

It should be noted that some of the components in the second composition may be the same as some of the components in the first composition. Preferably, however, the first composition is devoid of moisture-sensitive components, such 5 as a bleach.

The second composition may be a solid or a liquid. Preferably, the second composition is a compressed solid or a particulate solid.

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The second composition is contained in a second compartment. In one embodiment, the second compartment is defined by a housing formed of a water-soluble polymer, such as one of the polymers mentioned herein. The housing may be 15 formed using any of the methods described herein, including, for example, thermoforming and injection moulding. In one embodiment, the second composition is in the form of a solid, for example, a solid ball or pill, which is surrounded by a coating of a suitable material. The second 20 compartment may be placed in the first compartment, before the first compartment is sealed.

The second composition may alternatively be included in a sealing member, which is placed on top of the pocket and 25 sealed thereto. In one embodiment, a coated ball or pill may be coupled to the sealing member using an adhesive, or mechanical means, such that when the sealing member is placed over the pocket, the coated ball or pill is at least partially enclosed by the first compartment. This 30 arrangement may be especially appropriate when the sealing member has a degree of rigidity, for example, when it has been produced by injection moulding.

It is also possible for a previously prepared container containing the second composition to be adhered to the sealing member. For example, a sealing member in the form 5 of a film may have a partially or completely filled compartment containing a composition attached thereto. The second composition or compartment may be held on the under side of the sealing member, such that when the sealing member is positioned over the pocket, the second compartment 10 extends inside the first compartment. In a preferred embodiment, the first compartment is only partially filled before the sealing member is placed over it. However, once the sealing member is placed over the first compartment, the first compartment appears to be full, because of the volume 15 occupied by the second compartment.

In one embodiment, the underside of the sealing member is provided with a housing for the second composition. This is especially appropriate when the sealing member is 20 flexible, for example in the form of a film. When the sealing member is placed over the first compartment, the housing is positioned within the first compartment. Thus, any composition contained within the housing may be at least partially enclosed by the first composition in the first 25 compartment. Such a housing may conveniently be formed by thermoforming. It may be possible to fill the housing with the second composition before or after the sealing member is placed over the first compartment. Preferably, the housing is filled before the first compartment is sealed with the 30 sealing member.

The sealing member may be placed on top of the pocket and sealed thereto. For example, the sealing member in the form of a film may be placed over a filled pocket and across the sealing portion, if present, and the films sealed 5 together at the sealing portion. In general, there is only one compartment or composition in or on the sealing member, but it is possible to have more than one compartment or composition if desired, for example 2 or 3 compartments or compositions.

10

The second compartment may be formed by any technique. For example it can be formed by vertical form fill sealing the second composition within a film, such as by the process described in WO 89/12587. It can also be formed by having an 15 appropriate shape for an injection moulding.

However, it is preferred to use a vacuum forming or thermoforming techniques, such as that previously described in relation to the first compartment of the container of the 20 present invention. Thus, for example, a pocket surrounded by a sealing portion is formed in a film, the pocket is filled with the second composition, a film is placed on top of the filled pocket and across the sealing portion and the films are sealed together at the sealing portion. In 25 general, however, the film placed on top of the filled pocket to form the second compartment does not itself comprise a further compartment.

Further details of this thermoforming process are 30 generally the same as those given above in relation to the first compartment of the container of the present invention.

All of the above details are incorporated by reference to the second compartment, with the following differences:

5 The second compartment is smaller than the first compartment. In general the first compartment and the second compartment (or composition if not held within a compartment) have a volume ratio of from 2:1 to 20:1, preferable 4:1 to 10:1. Generally the second compartment does not extend across the sealing portion.

10

The thickness of the film comprising the second compartment may also be less than the thickness of the film making up the first compartment of the container of the present invention, because the film is not subjected to as 15 much localised stretching in the thermoforming step. It is also desirable to have a thickness which is less than that of the film used to form the first compartment to ensure a sufficient heat transfer through the film to soften the base web if heat sealing is used.

20

The thickness of the covering film is generally from 20 to 160 μm , preferably from 40 to 100 μm , such as 40 to 80 μm or 50 to 60 μm .

25 This film may be a single-layered film but is desirably laminated to reduce the possibility of pinholes allowing leakage through the film. The film may be the same or different as the film forming the first compartment. If two or more films are used to form the film comprising the 30 second compartment, the films may be the same or different. Examples of suitable films are those given for the film forming the first compartment.

The first compartment and the sealing member may be sealed together by any suitable means, for example by means of an adhesive or by heat sealing. Mechanical means is 5 particularly appropriate if both have been prepared by injection moulding. Other methods of sealing include infrared, radio frequency, ultrasonic, laser, solvent, vibration and spin welding. An adhesive such as an aqueous solution of PVOH may also be used. The seal desirably is water-10 soluble if the containers are water-soluble.

If heat sealing is used, a suitable sealing temperature is, for example, 120 to 195°C, for example 140 to 150°C. A suitable sealing pressure is, for example, from 250 to 600 15 kPa. Examples of sealing pressures are 276 to 552 kPa (40 to 80 p.s.i.), especially 345 to 483 kPa (50 to 70 p.s.i.) or 400 to 800 kPa (4 to 8 bar), especially 500 to 700 kPa (5 to 7 bar) depending on the heat sealing machine used. Suitable sealing dwell times are 0.4 to 2.5 seconds.

20

One skilled in the art can use an appropriate temperature, pressure and dwell time to achieve a seal of the desired integrity. While desirably conditions are chosen within the above ranges, it is possible to use one or 25 more of these parameters outside the above ranges, although it would might be necessary to compensate by changing the values of the other two parameters.

In an embodiment of the invention, the sealing member 30 does not comprise the second composition at the time it is placed on top of the first component. Instead the second composition is added afterwards. Thus, for example, it is

possible for the sealing member to contain a housing, which is filled, either before or after sealing, by a liquid composition that is allowed to gel in-situ.

5 If more than one container is formed at the same time from the same sheet, the containers may then be separated from each other, for example by cutting the sealing portions, or flanges. Alternatively, they may be left conjoined and, for example, perforations provided between

10 the individual containers so that they can be easily separated a later stage, for example by a consumer. If the containers are separated, the flanges may be left in place. However, desirably the flanges are partially removed in order to provide an even more attractive appearance.

15 Generally the flanges remaining should be as small as possible for aesthetic purposes while bearing in mind that some flange is required to ensure the two films remain adhered to each other. A flange having a width of 1 mm to 8 mm is desirable, preferably 2 mm to 7 mm, most preferably

20 about 5 mm.

25 The containers may themselves be packaged in outer containers if desired, for example non-water soluble containers which are removed before the water-soluble containers are used.

30 The containers produced by the process of the present invention, especially when used for a fabric care, surface care or dishwashing composition, may have a maximum dimension of 5 cm, excluding any flanges. For example, a container may have a length of 1 to 5 cm, especially 3.5 to

4.5 cm, a width of 1.5 to 3.5 cm, especially 2 to 3 cm, and a height of 1 to 2 cm, especially 1.25 to 1.75 cm.

The primary composition and the secondary composition 5 may be appropriately chosen depending on the desired use of the container.

If the container is for use in laundry washing, the first composition may comprise, for example, a detergent, 10 and the second composition may comprise a bleach, stain remover, water-softener, enzyme or fabric conditioner. The article may be adapted to release the compositions at different times during the laundry wash. For example, a bleach or fabric conditioner is generally released at the 15 end of a wash, and a water-softener is generally released at the start of a wash. An enzyme may be released at the start or the end of a wash.

If the container is for use as a fabric conditioner, 20 the first composition may comprise a fabric conditioner and the second composition may comprise an enzyme which is released before or after the fabric conditioner in a rinse cycle.

25 If the container is for use in dish washing the first composition may comprise a detergent and the second composition may comprise a water-softener, salt, enzyme, rinse aid, bleach or bleach activator. The article may be adapted to release the compositions at different times 30 during the laundry wash. For example, a rinse aid, bleach or bleach activator is generally released at the end of a

wash, and a water-softener, salt or enzyme is generally released at the start of a wash.

Preferably, the container is for use in laundry
5 washing.

The containers of the present invention will now be further described with reference to Figures 1. This illustrates an example of a container which can be produced.

10

Figure 1 depicts a container 10 comprising a first composition 12, and a second compartment 14 which comprises, for example, a bleach. The first composition 12 is held within the container 10 in a first compartment 16. The 15 second composition is held within a second compartment 18. The second compartment 18 is provided on the underside of a sealing member 20, which sealingly engages the first compartment 16.

20

The first composition 12 is an anhydrous laundry detergent composition. The second composition 14 is a bleach. The first composition 12 is a transparent gelled liquid, whereas the second composition 14 is a particulate solid.

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Examples

Comparative Example A

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A two-compartment container was formed as follows:

A film of PVOH (PT75 Aicello) was sealed by hand to form an open sachet, which was subsequently filled with 8g of a dish-washing gel (see Gel 1 in Table 1 below). The

gel-containing sachet was then sealed. A similar open sachet was filled with 12g of a moisture-sensitive powder (see Powder 1 in Table 1 below). This powder-filled sachet was then sealed, and placed adjacent the first sachet to form 5 the two-compartment container. 50% of the surface area of the powder-containing compartment was enclosed by the gel-containing compartment.

10

Example 1

15

A three-compartment container was formed as follows:

15

A film of PVOH (PT75 Aicello) was sealed by hand to form an open sachet, which was subsequently filled with a 12g of a moisture sensitive powder (see Powder 1 in Table 1 below). The powder-containing sachet was then sealed. Two 20 further open sachets were each filled with 8g of a dish-washing gel (see Gel 1 in Table below). Each gel-filled sachet was then sealed, and placed on opposite sides of the powder-filled sachet to form a three-compartment container. Almost 100% of the surface area of the powder-containing 25 compartment was enclosed by the gel-containing compartments.

Example 2

The containers of Comparative Example A and Example 1 30 were stored under 40°C and at 75%relative humidity for 4 weeks.

The amount of TAED and benzotriazole in the containers of Comparative Example A and Example 1 was measured over the four weeks. It was found that TAED and benzotriazole were found to be at least 50% more stable in the container of 5 Example 1 than in the container of Comparative Example A. In the container of Comparative Example A, more O₂-gas was formed than in Example 1.

10

Table 1

Raw materials	Gel 1	Powder 1
Sodium tripolyphosphate	48.75	%
Sodium tripolyphosphate	46.27	
Sodium carbonate	36.00	
Sodium percarbonate	10.83	
TAED	3.33	
Non-ionic surfactant	31.50	
Benzotriazole	0.42	
Homopolymer	2.00	
Polyglycol	14.00	
Dye	1.00	
Properase	2.50	
Amylase	1.25	
Thickener	1.00	
Non-ionic surfactant	1.15	
	100.00	100.00

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